Experiment No.: 10

Name of the Experiment: Experimental Study of Unipolar PWM Circuit, Bipolar PWM Circuit, Three Phase Inverter Circuit and DC-DC Boost Converter Using PI Controller

Objectives:

- To Know about Unipolar PWM Circuit and Bipolar PWM Circuit
- To Know and Implement Three Phase Inverter Circuit in Simulink
- To Implement Boost Converter Using PI Controller

Software Package:

- MATLAB
- Simulink

Unipolar PWM Circuit:

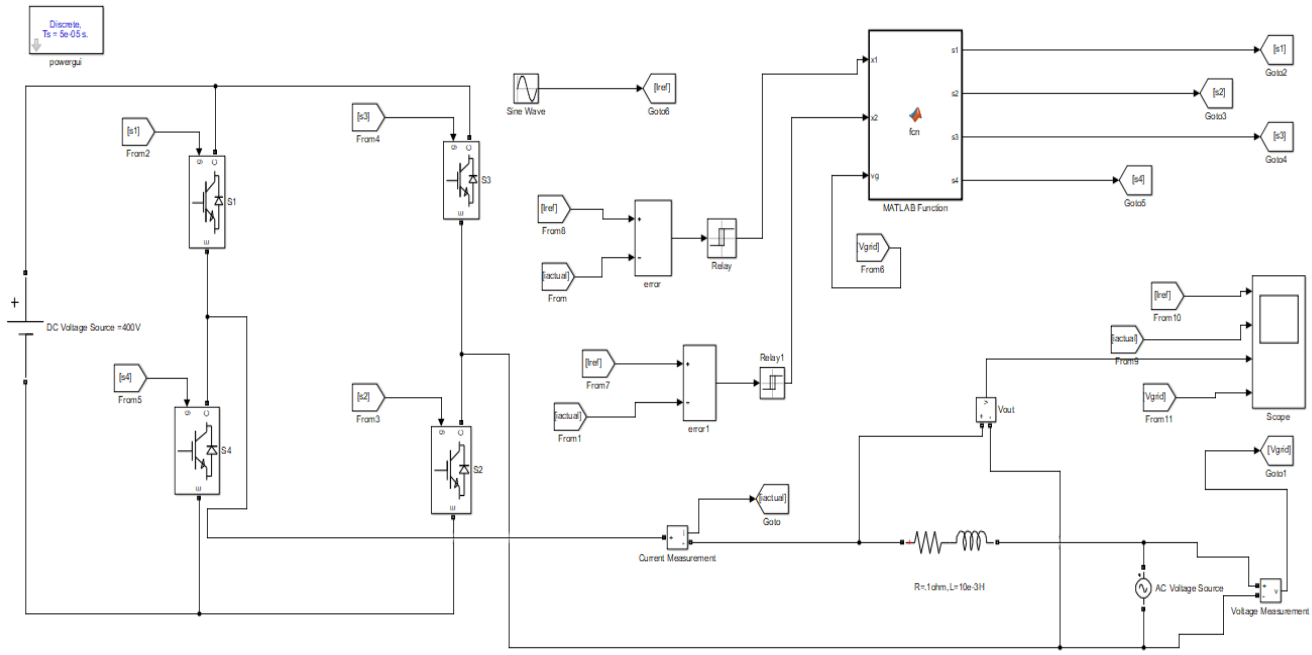

Figure 10.1.: Unipolar PWM Circuit in Simulink

MATLAB CODE:

```
function [s1,s2,s3,s4] = fcn(x1,x2,vg)
if vg>0
if x1 ==1
    s1 = 1; s2 =1;s3 = 0;s4 = 0;
else
    s1 = 1; s2=0;s3 =1;s4 = 0;
end
else
    if x2 ==1
        s3 =1;s4 = 1;s1=0;s2=0;
```

```
    else
        s3 = 0;s4 = 1;s2=1;s1 = 0;
    end
end
```

Output:

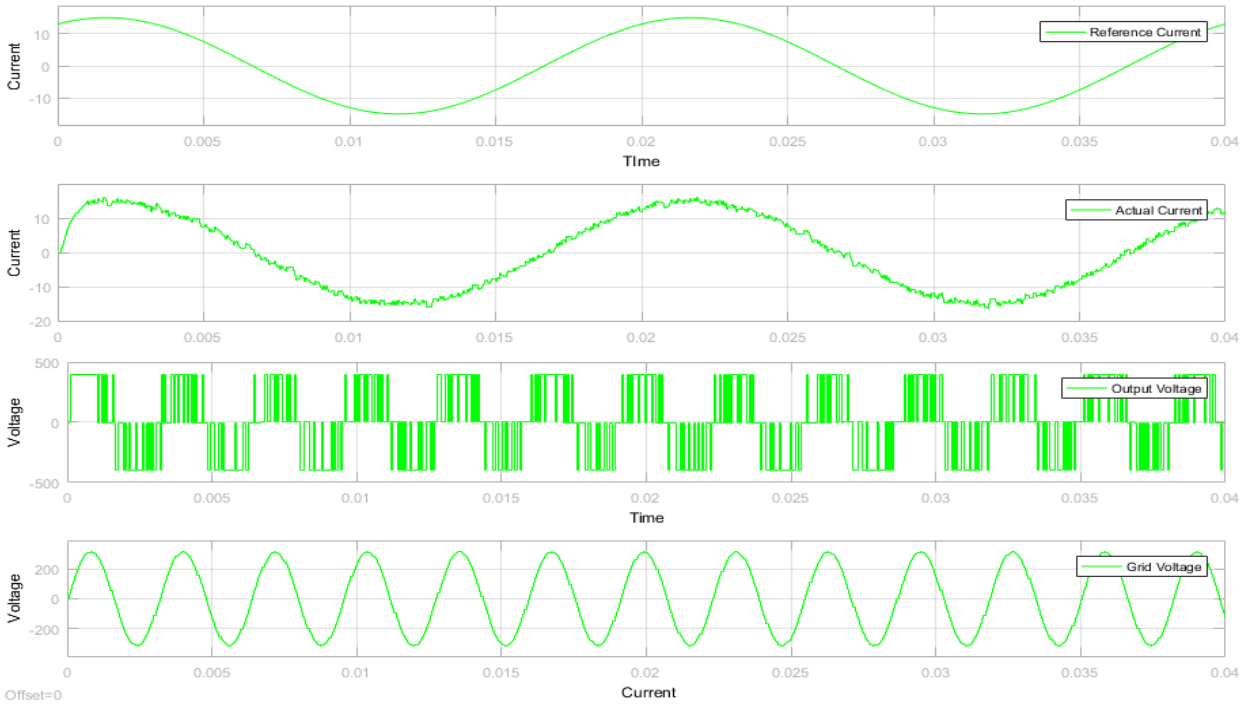

Figure 10.2.: Input-Output graph of Unipolar PWM Circuit in Simulink

Bipolar PWM Circuit:

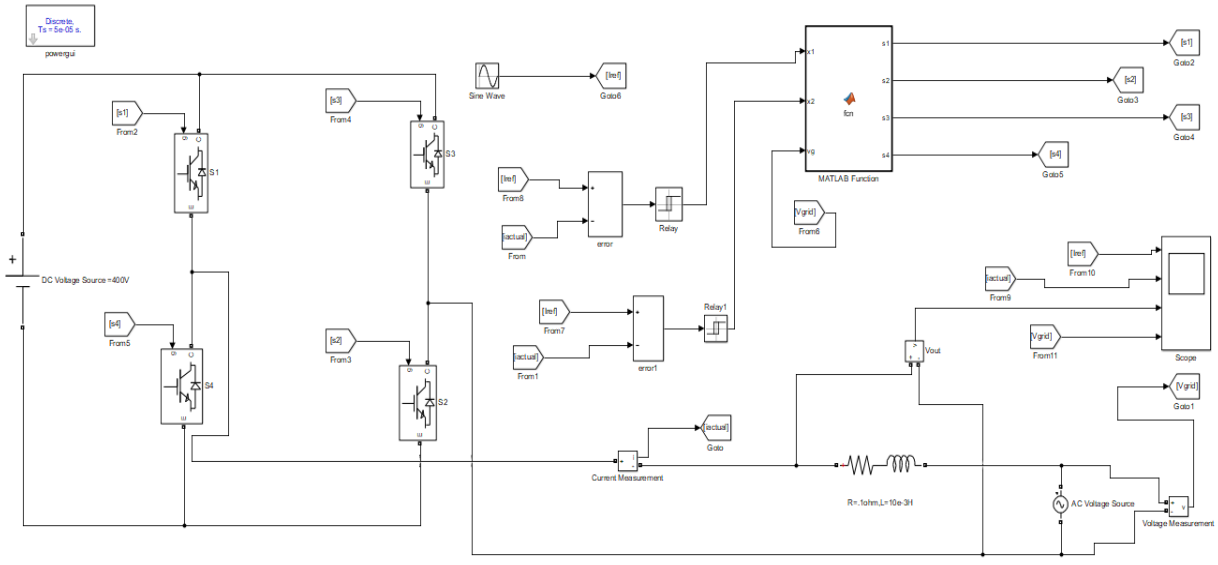

Figure 10.3: Bipolar PWM Circuit in Simulink

MATLAB CODE:

```
function [s1,s2,s3,s4] = fcn(x1,x2,vg)
if vg>0
if x1 ==1
    s1 = 1; s2 =1;s3 = 0;s4 = 0;
else
    s3 =1;s4 = 1;s1=0;s2=0;
end
else
    if x2 ==1
        s3 =1;s4 = 1;s1=0;s2=0;
    else
        s1 = 1; s2 =1;s3 = 0;s4 = 0;
    end
end
```

Output:

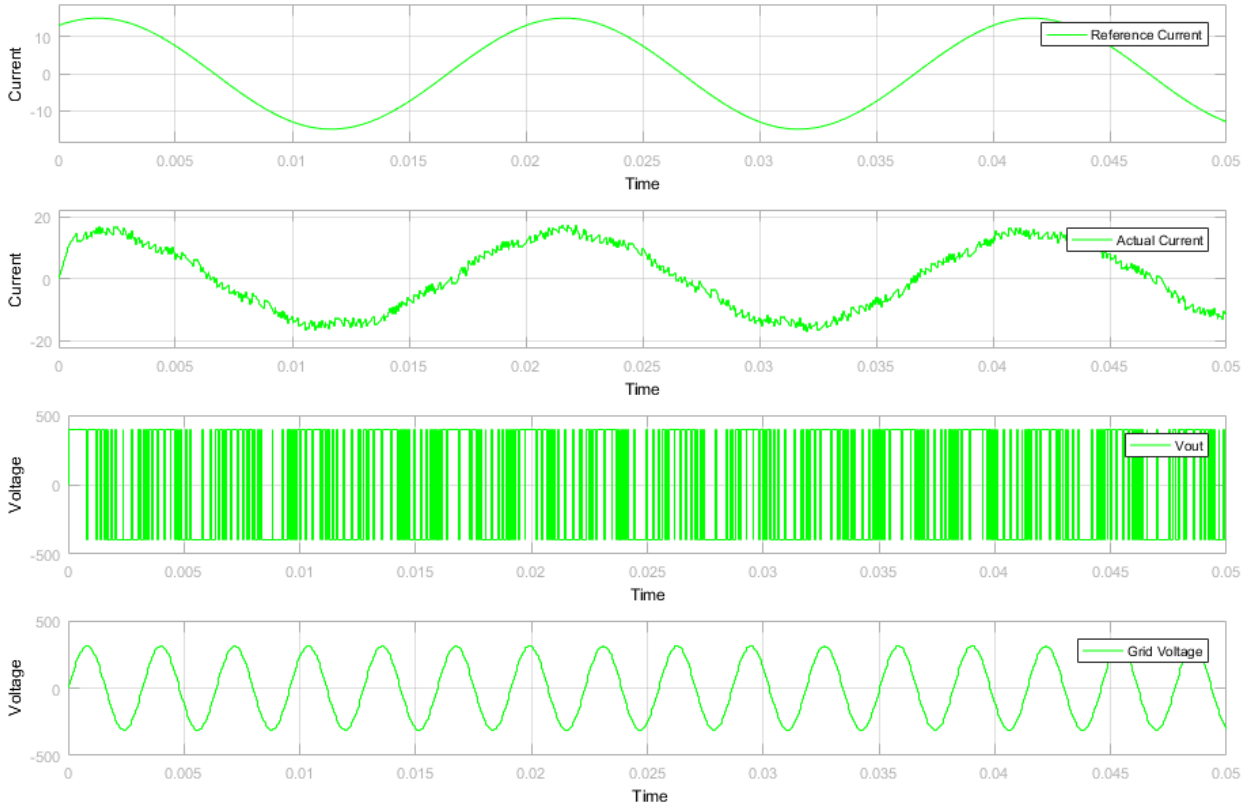

Figure 10.4.: Input-Output Graph of Bipolar PWM Circuit in Simulink

DC-DC Boost Converter Using PID Controller:

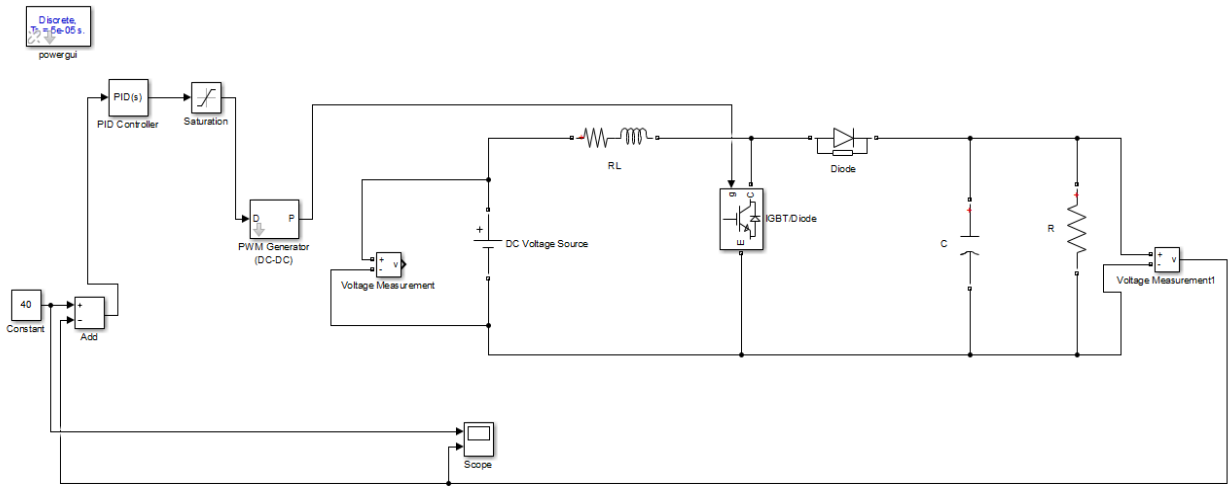

Figure10.5.: DC-DC Boost Converter Circuit in Simulink using PI Controller where Vref = 40V

Output:

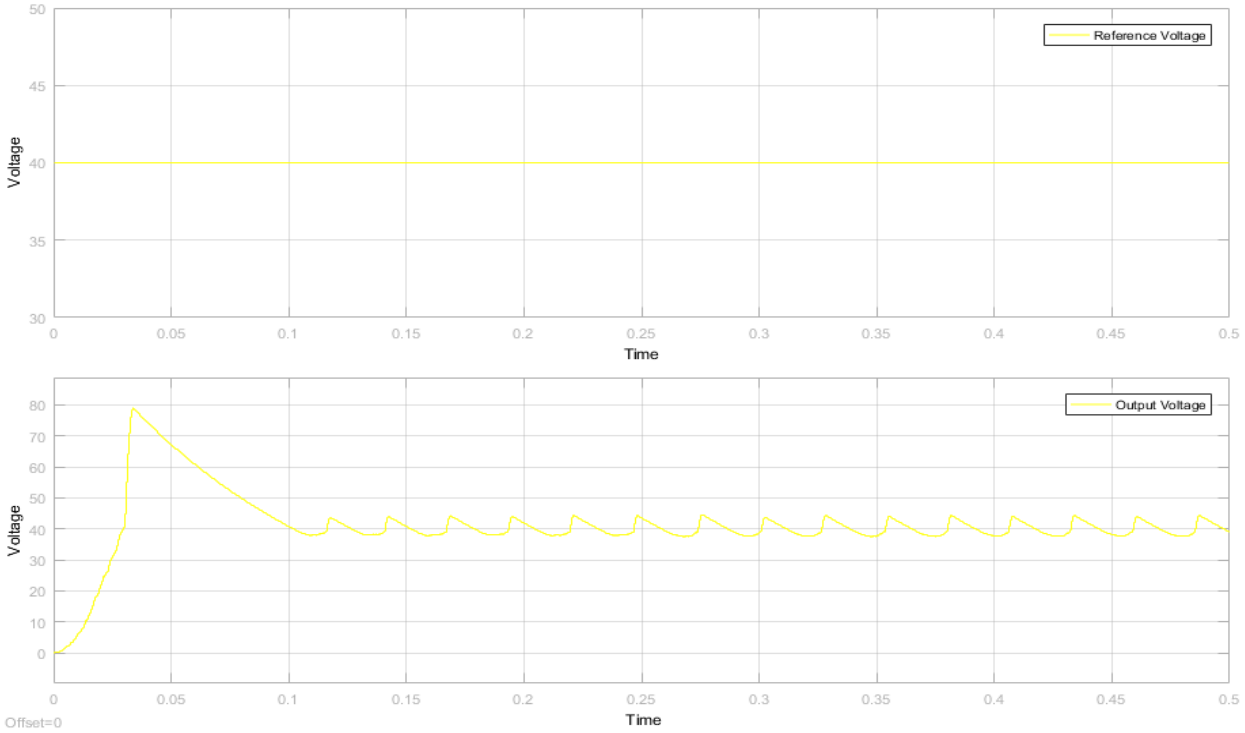

Figure10.6.: Input-Output Graph of DC-DC Boost Converter In Simulink for Vref = 40V

Three Phase Inverter using Bipolar PWM:

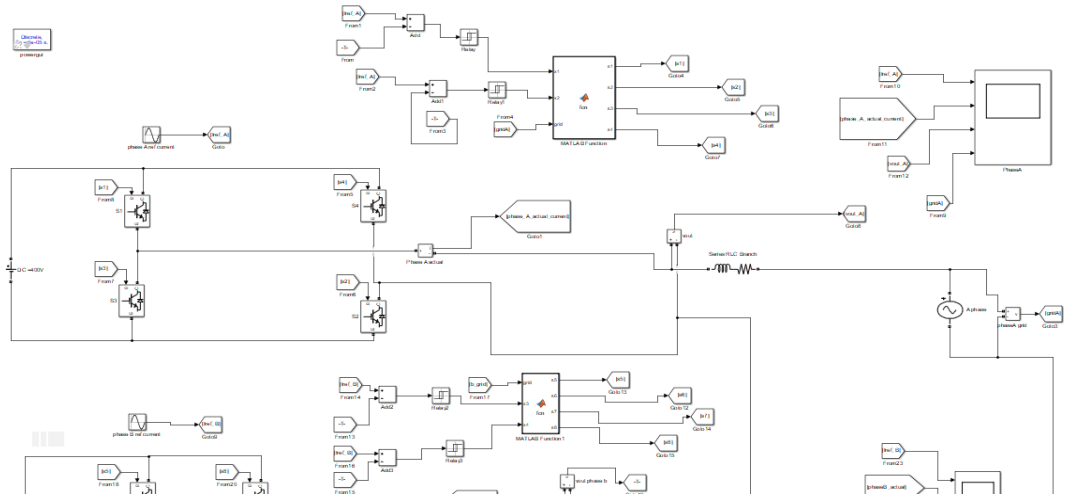

Figure 10.7.: Phase A of Three Phase Inverter using Bipolar PWM in Simulink

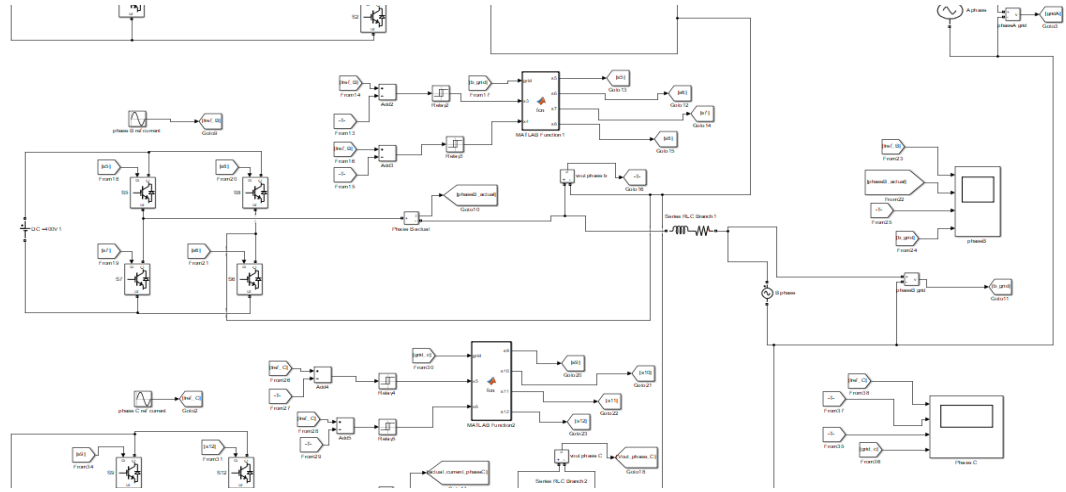

Figure 10.8.: Phase B of Three Phase Inverter using Bipolar PWM in Simulink

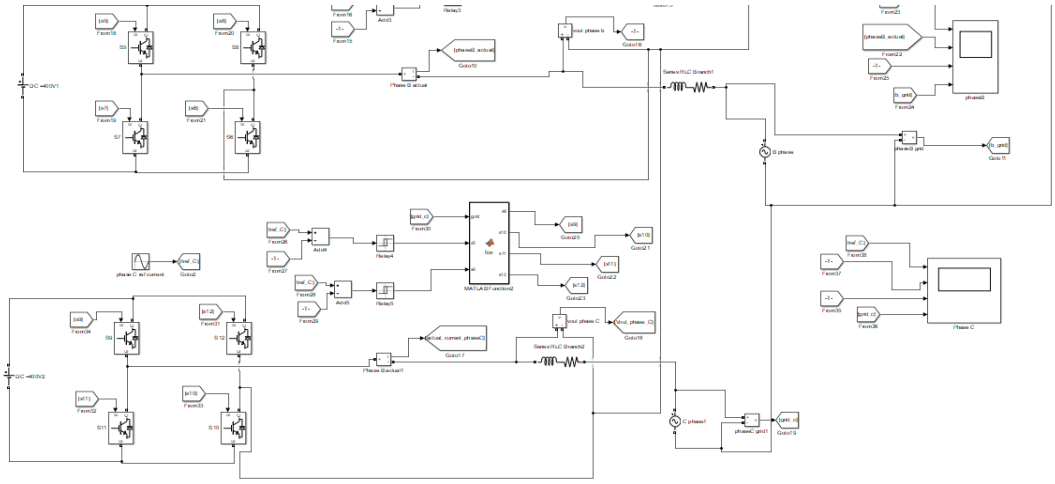

Figure 10.9.: Phase C of Three Phase Inverter using Bipolar PWM in Simulink

MATLAB CODE:

For phase A:

```
function [s1,s2,s3,s4]= fcn(x1,x2,grid)
if grid>0
    if x1 == 1
        s1 = 1;s2=1;s4=0;s3 = 0;
    else
        s1= 0;s2 = 0;s3 =1;s4 = 1;
    end
else
    if x2 == 1
        s3=1;s4=1;s2=0;s1=0;
    else
        s2=1;s1=1;s3=0;s4=0;
    end
end
```

for phase b:

```
function [s5,s6,s7,s8]= fcn(grid,x3,x4)
if grid>0
    if x3 == 1
        s5 = 1;s6=1;s8=0;s7 = 0;
    else
        s5= 0;s6 = 0;s7 =1;s8 = 1;
    end
else
    if x4 == 1
        s7=1;s8=1;s6=0;s5=0;
    else
        s6=1;s5=1;s7=0;s8=0;
    end
end
```

for phase c:

```
function [s9,s10,s11,s12]= fcn(grid,x5,x6)
if grid>0
    if x5 == 1
        s9 = 1;s10=1;s12=0;s11 = 0;
    else
        s9= 0;s10 = 0;s11 =1;s12 = 1;
    end
else
    if x6 == 1
        s11=1;s12=1;s10=0;s9=0;
    else
        s10=1;s9=1;s11=0;s12=0;
    end
end
```

Output: Phase A:

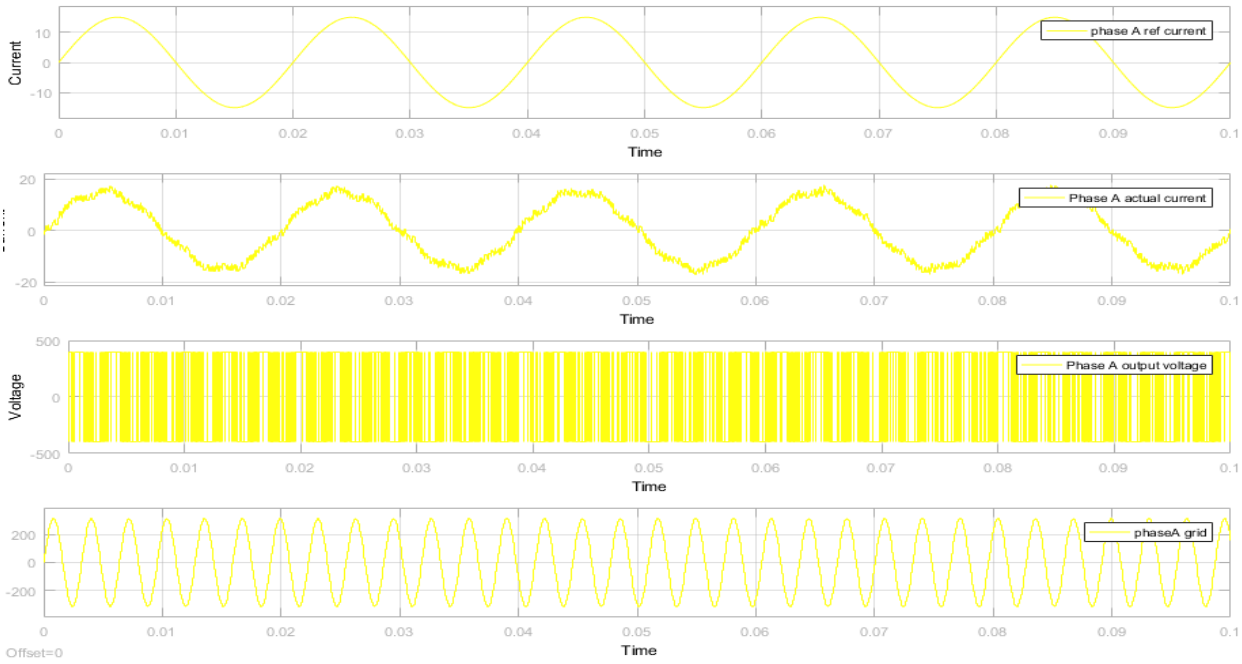

Figure 10.10.: Input-Output graph of Three Phase Inverter Using Bipolar PWM in Simulink for phase A

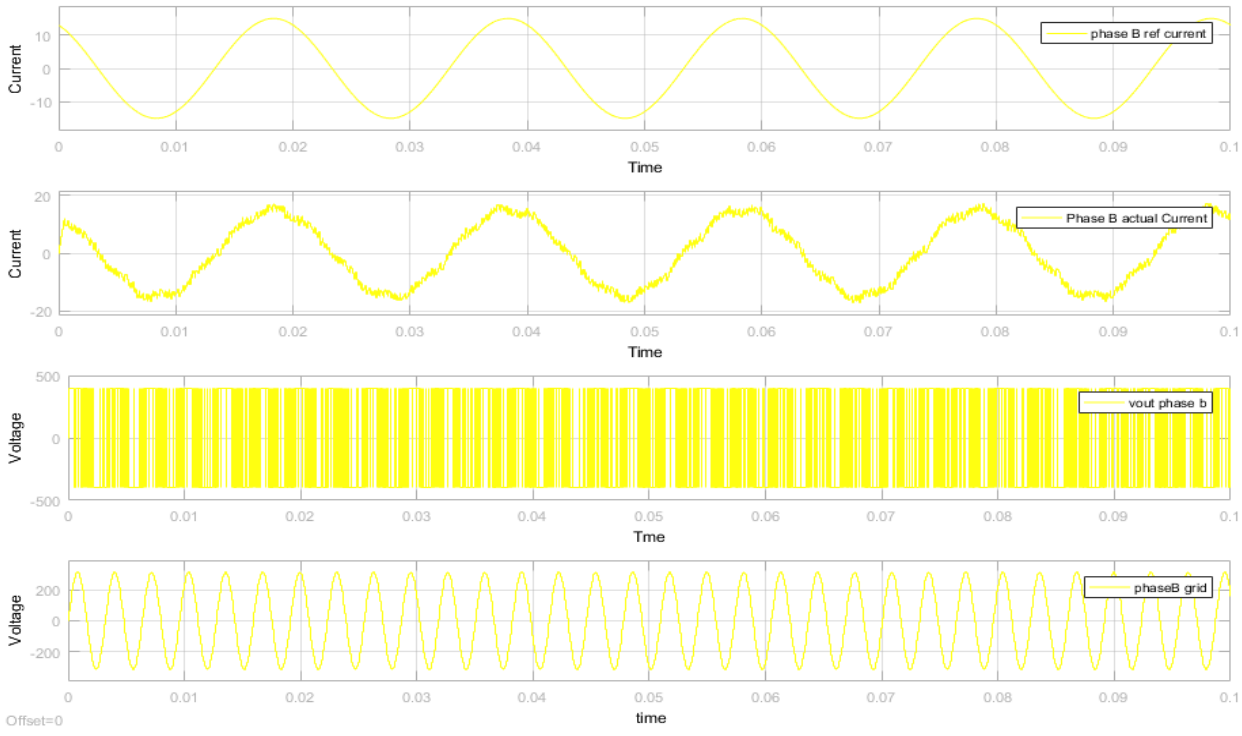

Figure 10.11.: Input-Output graph of Three Phase Inverter Using Bipolar PWM in Simulink for phase B

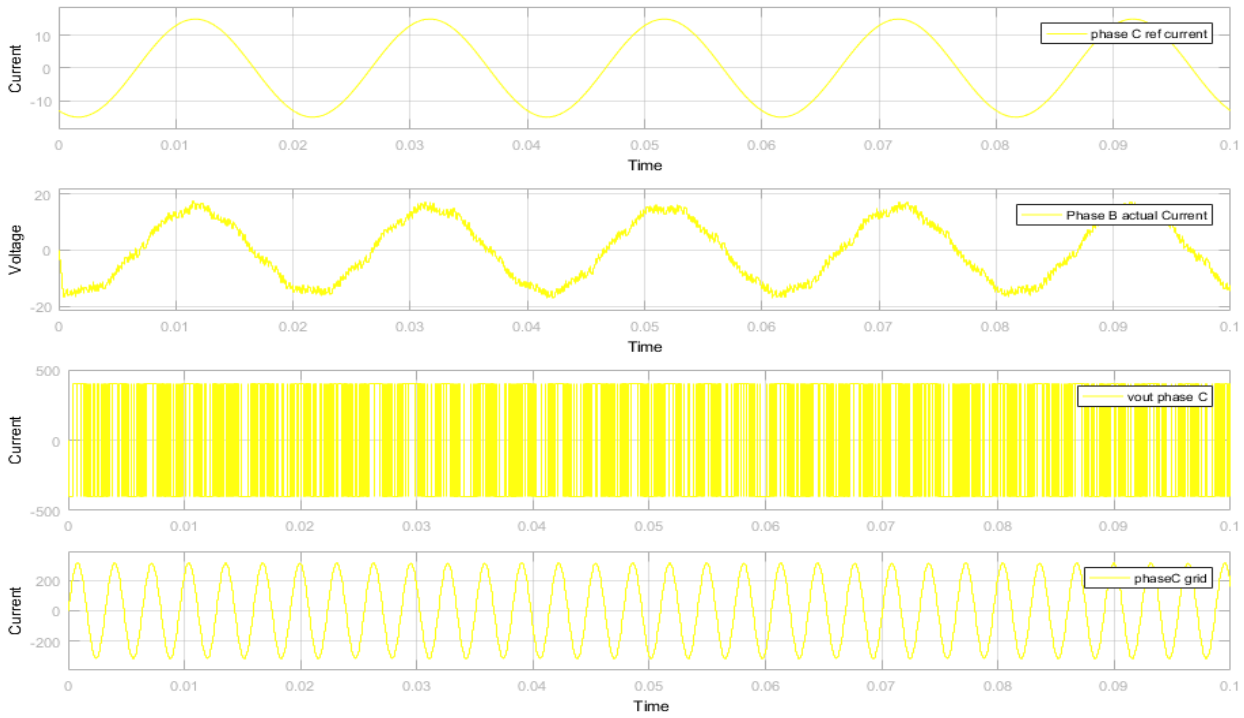

Figure 10.12.: Input-Output graph of Three Phase Inverter Using Bipolar PWM in Simulink for phase C

Discussion: In this experiment, Single phase Bipolar and Unipolar PWM Inverter circuit, three phase inverter using Bipolar PWM, and DC-DC boost converter circuit was implemented. In dc-dc boost converter the desired voltage was 40v and the circuit was successful in tracking the reference voltage that can be seen from the output graph. The Bipolar and Unipolar PWM method was implement in the single-phase inverter and it can be seen from dc supply voltage the desired or reference current was generated from the circuit in the scope. Also, in three phase inverter it can be seen that phase A current, phase B current and phase C currents are having 120-degree phase difference. So, the experiments have yielded the desired output.